

PRELIMINARY SURVEY AND BIOGEOGRAPHIC ANALYSIS OF THE BIRDS OF THE SURIN ISLANDS, THAILAND

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SUMMARY

The Surin Islands, 53 km off the west coast of peninsular Thailand, comprise a North Island of 18.7 square km and a South Island of 11.6 square km separated by a very narrow strait. They are covered with relatively undisturbed evergreen forest and have numerous coves, peninsulas, small beaches and a few patches of mangroves.

A brief visit to the islands in November, 1975, and a survey of fauna and flora during April 12-21, 1976, revealed at least 39 species of resident terrestrial and freshwater birds. This bird fauna consists almost entirely of species typical of coastal or island habitats, species typical of disturbed or secondary mainland habitats, or species very common on the nearby mainland. The fauna is evidently a secondary one derived from colonists arriving after the islands separated from the peninsula during recession of the last glaciation. In comparison with species-area data available for bird communities on islands in other parts of the world, the number of species resident on the Surin Islands seems large. It is hypothesized that this is partly due to the islands' division into two islands and irregular shape, which cause the species to be distributed into partially isolated subpopulations and thereby reduce the overall extinction rate on the islands.

Introduction

Perhaps the last still unspoiled islands of significant size in Thai waters are Ko Surin Nua and Ko Surin Tai (North Surin Island and South Surin Island). This report describes the results of preliminary surveys of the land and freshwater birds on the islands carried out during Nov. 27-29, 1975, and April 12-21, 1976, and discusses the

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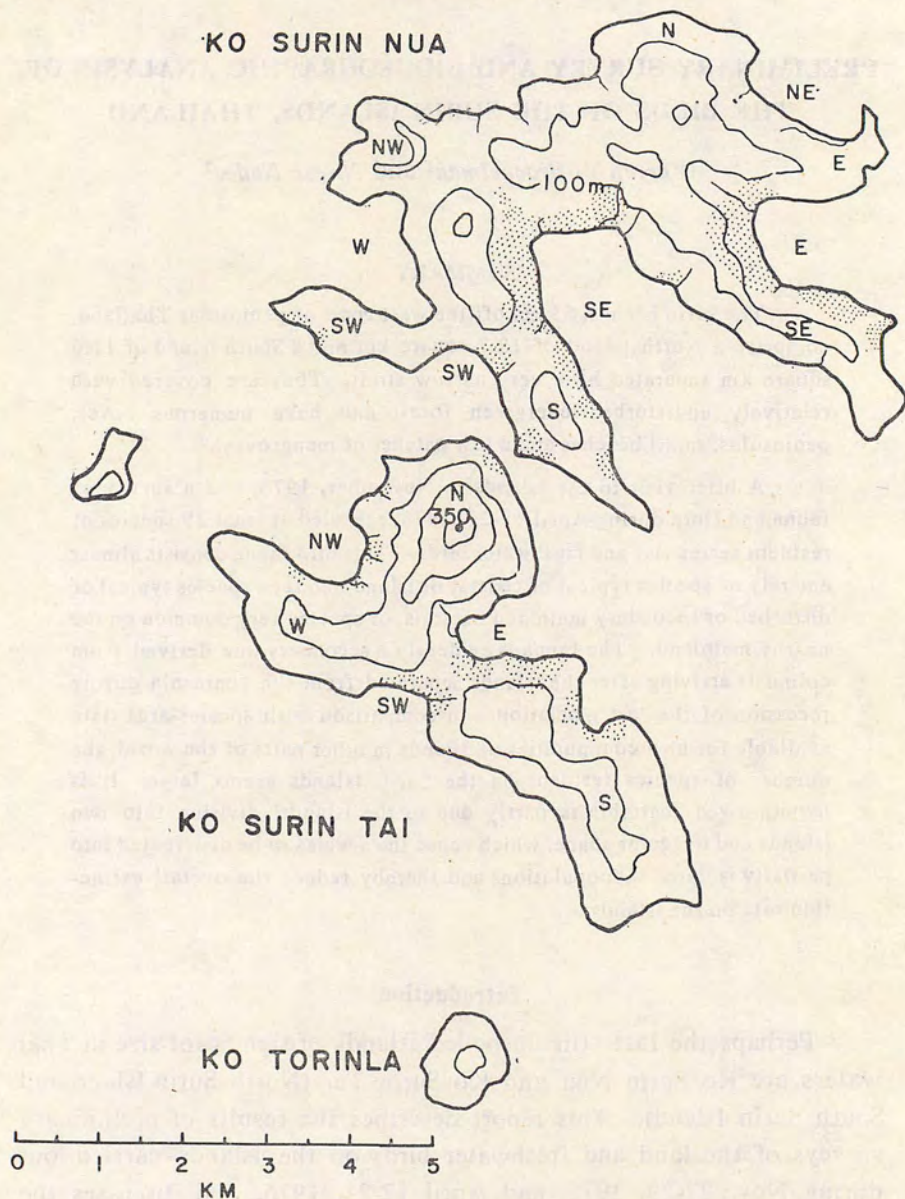


Figure 1. North and South Surin Island, showing 100 m contour lines and small streams. The stippled area indicates the approximate distribution of secondary vegetation. Information for the west and north sides of N. Island is incomplete, as these areas were not visited. Coves and peninsulas have been given compass direction names.

resident bird communities in the context of island biogeographical theory (MACARTHUR and WILSON, 1967). The main questions of interest were: What kinds of birds reside on offshore islands such as these? What diversity of species do islands of this size, shape, and distance from the mainland support? Do North and South Surin Islands, so close together, have the same or different species?

The Surin Islands were visited by Stanford University's research vessel *Te Vega* while participating in the United States Programme in Biology, International Indian Ocean Expedition, on Nov. 5-7, 1963. On this visit, Frank B. Gill collected 12 species of birds from the North Island for the Smithsonian Institution (DICKINSON, 1966). These specimens have the locality label "Goh Sindarar Nua." The nonmarine species are incorporated in our list.

Our April trip, aboard the Phuket Marine Biological Centre's *Pramong 8*, was conceived as a biological survey of the islands to determine their possible value as a wildlife and marine sanctuary. It was a cooperative venture involving the Siam Society, Royal Thai Forest Department, Department of Fisheries (Phuket Marine Biological Centre), Applied Scientific Research Corporation of Thailand, and personnel from a variety of other institutions.

The Islands

The Surin Islands are located in Ranong Province at 9°23' to 9°29'N latitude and 97°50' to 97°55'E longitude, 53 km from the west coast of the Peninsula. They are also known by other names, including "Goh Sindarar" on British Admiralty Charts and "Ko Chan" on the old edition U.S. Army Map Sheets NC47 and many Thai road maps. Information in this report is taken from the current 1:250,000 scale Series 1501S, Sheet NC47-10 (Changwat Ranong), Edition 1RTSD, which employs the name "Ko Surin."

The North Island is approximately 18.7 square km and the South Island, 11.6 square km. They are separated by a narrow strait about 200 m wide which can be waded at very low tides (Figure 1). The highest elevations are 350 m on S. Island and about 240 m on N. Island.

Lying well within the 50 fathom depth line, the islands were connected to the Sunda Shelf land mass during the most recent Pleistocene glaciation 10,000 to 20,000 years ago (BROECKER, 1966; MERCER, 1972).

An interesting and perhaps biologically significant feature of the islands is their irregular shape, with numerous coves and peninsulas (Figure 1; Plate VIII, Figure 1). The total length of shoreline is 36.9 km on N. Island and 23.0 km on S. Island. The coves tend to be separated by steep ridges of 100 m or more in elevation and provide somewhat isolated sectors which contain the greatest variety of habitat types, such as small freshwater marshes and swamps (Plate VIII, Figure 2; Plate IX, Figure 1), beach vegetation, a variety of secondary vegetation and some patches of mangroves (Plate IX, Figure 2). Almost the only flat topography is located in the coves. Sandy beaches above high tide are confined to cove areas; the remaining shore area consists of granite rock.

Fresh water is easily found on both islands, even in the driest season. There are at least 30 permanent springs on the islands, located at the bases of the ravines, and small brooks descend through the lower reaches of the larger valleys.

The structure and species composition of selected forest vegetation is described by SMITINAND (this volume). Floristically, the vegetation is similar to that on peninsular Thailand. Most slopes and ridges are covered with undisturbed rain forest with a canopy reaching 30 or 35 m. However, secondary vegetation, probably of natural origin, grows over many hillsides and coves (Figure 1), and covers an estimated 10-20% of the islands. This habitat is rich in bird life. Beach vegetation of trees and shrubs is well-developed in most coves, especially on S. Island, and is a favorite habitat of sunbirds, flowerpeckers, and other small birds. Mangrove forest, comprising species of *Rhizophora* and *Bruguiera* is confined to the SE and E Coves of N. Island, and totals about 6 ha in area.

The Surin Islands are still unpopulated and unspoiled. Small rustic shelters in some of the coves indicate that fishermen are probably occasional temporary residents.

Fig. 1. Beach in the NW Cove of S. Island.



Fig. 2. Freshwater marshy babitat in E Cove of S. Island.



Fig. 1. Dense freshwater swamp vegetation on east side of SE Cove, N. Island.



Fig. 2. Intertidal flat and mangroves bordering SE Cove, N. Island.

Methods

We searched for birds intermittently during 6 days on N. Island and 3 days on S. Island, and collected by mist net and gun on N. Island, mostly in the SE Cove, and at the northern tip of S. Island. The areas visited included only the E, SE, and SW Coves and intervening peninsulas on N. Island and most of S. Island except for the S. Peninsula. Some birding was done at the highest elevations on both islands.

Little attention was paid to sea birds, as time was limiting and our main interest was focussed on resident land and freshwater species that have successfully colonized the islands.

The skins collected are in the Thai National Reference Collection at the Applied Scientific Research Corporation of Thailand. They have not been studied for subspecific variation.

Results

Table 1 lists the species seen or collected on each island on our expeditions, and also indicates which species were collected on the 1963 *Te Vega* expedition. The kingfisher *Alcedo atthis* was collected in 1963 but not seen on subsequent trips, as was the migrant plover *Charadrius mongolensis* not listed.

Two species without certain identification are the pigeon *Treron bicincta*, common and vocal in the forest canopy but not seen clearly, and the flycatcher *Ficedula dumetoria*, which was not collected for confirmation. Other species have been identified only to generic or subgeneric level, as indicated. These are all included because they add to the biogeographic diversity, but future work will have to settle the identities. This list is preliminary and is likely to err on the low side in any event.

The total list for the Surin Islands will definitely include 54 species, of which 39 species are land and freshwater residents, exclusive of marine shoreline species such as the reef egret and thick-knee. A species is considered a "probable resident" on the islands if it is a resident on the nearby mainland. The possibility that a nonmigrant species occurred on the islands as a nonbreeding stray individual or small flock and was

found during the survey certainly exists, but its probability is small enough that, for our purposes here, we may ignore this as a significant problem. Most "resident" species were at a relatively high density and appeared to be giving territorial vocalizations, indicating the presence of true breeding populations.

What kinds of birds are most likely to occur on offshore islands? Island bird faunas are not representative samples of the mainland species "pools," but tend to be composed of species characteristic of secondary vegetation or species which have wide ecological tolerances (MAYR, 1965; DIAMOND, 1971, 1972, 1973; MACARTHUR *et al.*, 1972). Nearly all of the species resident on the Surin Islands are characterized in one or more of the following ways:

- (1) They are common and widespread on the near Peninsula (21 species);
- (2) They are characteristic of forest clearings, scrub or secondary vegetation or habitats disturbed by man (17 species);
- (3) They are partial to coastal habitats such as mangroves or estuaries, or specialize in offshore island habitats (8 species, excluding marine species).

Birds wandering across open expanses of water or other unsuitable habitat would logically be disproportionately drawn from these categories. Birds characterizing mature forest are greatly underrepresented, for these species are relatively sedentary in the sense that they do not ordinarily wander far from their home environments.

Birds specializing in or at least at home in offshore habitats include the ruddy and white-collared kingfishers, brown-throated sunbird, mangrove whistler, pied imperial pigeon, Nicobar pigeon, and Pacific swallow.

A striking aspect of the bird community on the Surin Islands is the paucity of species in the tall mature forest on the hillsides and ridges;

the best birding was in the lower ravines and secondary vegetation near the shore. Upland areas were well populated only by the ubiquitous greater racket-tailed drongo, Abbott's babbler, wreathed hornbill, and several pigeons.

Island bird faunas tend to be composed of fewer species which tend to be more abundant than populations of the same species on the mainland (CROWELL, 1962; MACARTHUR *et al.*, 1972). Although no quantitative comparisons were made in this study, it was our impression that several species were very abundant on the Surin Islands compared with mainland populations: Green imperial pigeon, brown hawk owl, black-headed bulbul, greater racket-tailed drongo, and Abbott's babbler. One could often hear 4 or 5 hawk owls calling at night and they could be heard on every part of the islands visited.

The islands have similar, but not identical, bird faunas. Of the total number of residents, 53% were found on both islands, 40% on N. Island only, and 7% on S. Island only. We cannot yet say that the difference between the islands is significant, except that the larger N. Island probably has a few more species than S. Island. Evidently, the narrow gap between the two islands is little barrier to the dispersal of the kinds of birds that are likely to colonize these islands, and some, such as the crows, hornbills and eagles, were seen flying high over the widest coves. More kingfishers occur on N. Island because of the mangrove habitat and more extensive intertidal flats.

Discussion

The main tenet of the theory of island biogeography is that the number of species on an island tends to approach an equilibrium set by the relative rates of colonization by new species, and of extinction of species on the island. These rates are likely to be complex functions of island area, variety of habitat types available, distance from the mainland, the number of species available on the mainland, and the

diversity of species already on the island. This theory has been surprisingly useful in explaining observed trends in island species diversity, for although individual species are often unpredictable in distribution or behaviour, whole communities or avifaunas have statistical properties which apparently have a high degree of predictability.

Island area is the best single predictor of island diversity (HAMILTON *et al.*, 1964; DIAMOND, 1973), probably mainly through its effect on the probability of extinction. Some extinction rates have been estimated from large "land-bridge" islands, which are islands on the continental shelves which became isolated from mainland areas when the level of the oceans rose after the last glaciation (DIAMOND, 1972; TERBORGH, 1974, 1975). In comparison with other islands, some of the large land-bridge islands seem to have more than their equilibrium number of species, and are probably still undergoing a gradual reduction of diversity. Since their original (preisolation) species number can be estimated from comparable mainland areas, their rate of species loss can also be estimated. From such calculations, it is apparent that smaller islands undergo much more rapid species loss than larger ones, and that an island as small as 100 square km would have had ample time to lose all of its original species during the last 10,000 years. If we extrapolate from estimates of extinction rates for land-bridge islands in the West Indies (TERBORGH, 1974, 1975) to an island of 30.3 square km, we can roughly estimate how fast the Surin Islands (treating the two islands as a single "island" for biogeographical purposes) would have lost species at their present size. If the islands originally had a fauna of 100 species, they would have lost 5% of these after the first 100 years, and 99% of the original residents would have disappeared after about 1905 years. We can be rather sure, therefore, that the present day bird fauna of the islands is entirely a secondary one derived from later colonizers. This explains why there are so few residents typical of the stable climax forest, and why there are no endemic species there which have had sufficient time in which to evolve differences from mainland populations.

How many species of birds should we expect on the Surin Islands? There are no data entirely suitable for making such a prediction, but DIAMOND (1973) has fitted species-area data from islands between 8 and 500 km from New Guinea with the function:

$$S = 12.3 A^{0.22},$$

where A is in square km. Inserting 30.3 square km for the Surin Islands gives a prediction of 26 species, compared with 39 so far actually found. In fact, no island surveyed near New Guinea below 100 square km seems to have as many species of birds as the Surin Islands. Why are there so many species there?

One possible reason is that the Thai Peninsula has a larger number of non-montane species from which colonizers may come; there are about 452 between the northernmost part of the Peninsula and the Malaysian border (LEKAGUL & CRONIN, 1974; HOLMES & WELLS, 1975), as compared with 325 lowland species on New Guinea. But another possible reason concerns the shape of the Surin Islands; the fact that there are two islands very close together, with many arms and peninsulas.

It has been claimed that peninsulas have the opposite effect on species diversity, and furthermore, that if we are designing a wildlife preserve, it should be as compact as possible, without "peninsulas," so as to minimize species loss (DIAMOND, 1975; WILSON and WILLIS, 1975). Also, corridors or barriers to dispersal such as highways are to be avoided (DIAMOND, 1972). The idea of a "peninsula effect" has been attributed to MACARTHUR & WILSON (1967, p. 115-116) who present a map showing the numbers of breeding birds in squares 300 miles on a side over all of North America. The squares containing the peninsulas of Florida, Baja California and Yucatan contain fewer species than those covering the mainland mass nearby. MACARTHUR & WILSON make the case that this is because immigration rates onto the peninsulas are

reduced by their relative isolation—they can receive colonists from only one direction. Additional reasons for lower diversity in these places include the facts that the peninsular areas tend to be relatively more homogeneous (RICKLEFS, 1973) and that they simply include less land area than is enclosed in other squares.

Granting some validity to the peninsula effect, however, it does not necessarily follow that an island with peninsulas has fewer species than a more compactly shaped island of the same area; the two claims are not identical. The "peninsula effect" deals with diversity only on a peninsula, not on the whole land mass. And, as argued by SIMBERLOFF & ABELE (1976), it may be premature to argue that two islands very close together (such as the Surin Islands) should have a lower equilibrium species number than a single large one. An effect so far neglected is the lowering of the extinction rate that may occur because of delayed or impaired dispersal between different parts of the area (cf. MAY, 1975). Such reduced dispersion would not appreciably delay colonization, but might mean that a population becoming locally extinct in one area would be able to persist in another. A relevant experiment would seem to be the classic one of HUFFAKER (1958), which demonstrated that in an experimental predator-prey system of two mites, stability was significantly increased by imposing barriers to dispersal which tended to subdivide the population. In similar fashion, diseases, competitors, predators, or climatic fluctuations might cause a species to become extinct on one part of the Surin Islands while sparing a subpopulation partially isolated on another part.

In fact the effect of area on species diversity is not so very great within a range of variation in area by a factor of 2 or 3. A halving of area still permits approximately 81% of the original species number on each half by itself and reduction to 1/3 permits 72% of the original diversity on each third. It is conceivable that on islands with the configuration of the Surin Islands, the effects of reduced competition and delayed dispersal between subdivisions more than compensate for the area effect, and even permit *each island* to have an equilibrium diversity greater than a single compact whole.

The above idea is an hypothesis which is only suggested by the present data. One way of testing it would be to compare diversity on islands of different shapes, but with identical areas, distance from the mainland, and habitat types. There is, incredibly enough, an island 37 km north of the Surin Islands almost identical in area, but nearly round in shape: Davis Island, 28.9 square km in area, with a perimeter/area ratio only 1.3 times that of a perfect circle of equal area (versus 3.1 for the Surin Islands). Davis Island is slightly higher (449 m) and is close to St. Matthew's Island, an additional potential source of immigrants, but otherwise a survey of this Burmese island could provide a valuable initial test of the configuration hypothesis.

In spite of my reservations concerning the "peninsula effect," I do not wish to challenge the overall importance of the theory of island biogeography to the design of wildlife reserves and to conservation in general. This new theory on the whole promises to be vitally important to our attempts to slow down or halt extinctions of species in natural communities and to manage reserved areas; however, several specific details and applications need further work and clarification.

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Table 1. Birds of the Surin Islands. Asterisk (*) indicates specimen(s) collected Apr. 12-22, 1976. Expedition 1: Nov. 5-7, 1963, on *Te Vega*; expedition 2: Nov. 27-29, 1975; expedition 3: Apr. 12-22, 1976, on *Pramong* 8. Under "status," R = probable resident; V = visitor.

Scientific name	English name	Island	Status	Expedition	Remarks
ARDEIDAE					
<i>Butorides striatus</i>	Little Heron	N	R	3	1 seen
<i>Egretta sacra</i>	Pacific Reef Egret	N,S	R	1,2,3	Common
<i>Ixobrychus sinensis</i> *	Yellow Bittern	N	R	3	1 seen
ACCIPITRIDAE					
<i>Haliastur indus</i>	Brahminy Kite	N	R	3	3 seen
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	N,S	R	2,3	
<i>Spilornis cheela</i>	Crested Serpent Eagle	N,S	R	3	
SCOLOPACIDAE					
<i>Numenius phaeopus</i>	Whimbrel	N	V	1,3	
<i>Actitis hypoleucos</i> *	Common Sandpiper	N,S	V	1,2,3	
<i>Gallinago</i> sp. (gallinago-like)	Snipe	S	V	3	1 seen
BURHINIDAE					
<i>Esacus magnirostris</i>	Great Thick-knee	N,S	R	1,2,3	several pairs
LARIDAE					
<i>Sterna sumatrana</i> *	Black Naped Tern	N	R	3	3+2 seen
<i>Sterna bergii</i>	Great Crested Tern	N	R	3	2 seen
COLUMBIDAE					
<i>Treron bicincta</i> (?)	Orange-breasted Pigeon	N,S	R	2,3	Common in forest
<i>Ducula aenea</i> *	Green Imperial Pigeon	N,S	R	1,3	Abundant
<i>Ducula bicolor</i>	Pied Imperial Pigeon	N	R	3	Common, especially E Cove
<i>Chalcophaps indica</i> *	Green-winged Pigeon	N,S	R	3	Common
<i>Caloenas nicobarica</i> *	Nicobar Pigeon	N,S	R	3	In most ravines

CUCULIDAE						
<i>Centropus sinensis</i>	Greater Coucal	N,S	R	2,3	Common	
STRIGIDAE						
<i>Ninox scutulata*</i>	Brown Hawk Owl	N,S	R	2,3	Common	
APODIDAE						
<i>Collocalia sp.</i>	Swiftlet	N,S	R	3	Common	
ALCEDINIDAE						
<i>Alcedo atthis</i>	Common Kingfisher	N	R	1	Common	
<i>Halcyon coromanda*</i>	Ruddy Kingfisher	N	R	3		
<i>Halcyon smyrnensis</i>	White-throated Kingfisher	N	R			
<i>Halcyon pileata</i>	Black-capped Kingfisher	N,S	V	1,2,3		
<i>Halcyon chloris</i>	Collared Kingfisher	N	R	1,3		
CORACIIDAE						
<i>Eurystomus orientalis</i>	Dollarbird	N,S	R	3		
BUCEROTIDAE						
<i>Rhyticeros undulatus</i>	Wreathed Hornbill	N,S	R	2,3	Common	
PICIDAE						
<i>Chrysocolaptes lucidus</i>	Greater Goldenback	S	R	3	E Cova	
HIRUNDINIDAE						
<i>Hirundo tahitica*</i>	Pacific Swallow	N,S	R	1,3		
PYCNONOTIDAE						
<i>Pycnonotus atriceps*</i>	Black-headed Bulbul	N,S	R	3	Abundant	
DICRURIDAE						
<i>Dicrurus paradiseus*</i>	Greater Racket-tailed Drongo	N,S	R	2,3	Abundant	
ORIOLIDAE						
<i>Oriolus chinensis</i>	Black-naped Oriole	N	V	3	1 seen	
<i>Irena puella</i>	Asian Fairy-bluebird	N	R	3	1+6 seen	
CORVIDAE						
<i>Corvus macrorhynchus</i>	Large-billed Crow	N,S	R	2,3	Flock of 3	

Scientific name	English name	Island	Status	Expedition	Remarks
TIMALIIDAE					
<i>Trichastoma abbotti</i> *	Abbott's Babbler	N,S	R	2,3	Abundant
TURDIDAE					
<i>Erithacus cyane</i> *	Siberian Blue Robin	N	V	3	1 netted
<i>Copsychus malabaricus</i> *	White-rumped Shama	N,S	R	3	Common
<i>Zoothera citrina</i>	Orange-headed Robin	N	R	2	1 seen, E Cove
SYLVIIDAE					
<i>Phylloscopus sp. (tenellipes ?)</i>	Warbler	N,S	V	3	Common
MUSCICAPIDAE					
<i>Ficedula zanthopygia</i> *	Yellow-rumped Flycatcher	N	V	3	1 collected
<i>Ficedula dumetoria</i> (?)	Rufous-chested Flycatcher	S	R	3	1 immature seen
<i>Culicicapa ceylonensis</i>	Grey-headed Flycatcher	N	R	3	1 seen
<i>Hypothymis azurea</i> *	Black-naped Monarch	N	R	3	Common
PACHYCEPHALIDAE					
<i>Pachycephala cinerea</i>	Mangrove Whistler	N	R	3	1 seen
MOTACILLIDAE					
<i>Motacilla flava</i>	Yellow Wagtail	N	V	3	Small flock
<i>Dendronanthus indicus</i>	Forest Wagtail	N	V	3	2 seen
STURNIDAE					
<i>Aplonis panayensis</i> *	Philippine Glossy Starling	N,S	R	3	Common
<i>Gracula religiosa</i>	Hill Myna	N,S	R	2,3	Common
NECTARINIIDAE					
<i>Anthreptes malacensis</i>	Brown-throated Sunbird	N	R	1,3	Beach shrubbery
<i>Nectarinia jugularis</i> *	Olive-backed Sunbird	N,S	R	1,3	
<i>Aethopyga siparaja</i>	Crimson Sunbird	N	R	3	
DICAENINAE					
<i>Dicaeum trigonostigma</i>	Orange-bellied Flowerpecker	N,S	R	3	Abundant near mangroves
<i>Dicaeum cruentatum</i>	Scarlet-backed Flowerpecker	N	R	3	1 seen, E Cove